Faculty Working Papers

ADVERTISING AND CONCENTRATION

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College of Commerce and Business Administration
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I. INTRODUCTION

Despite a decade of study, economists have been unable to agree on advertising's impact on concentration. Telser, Ekelund, Gramm, and Maurice[1] argue that advertising has no effect on concentration. Mann, Henning, and Meehan[2] contend that the two are intimately connected. The relationship is interesting for two reasons. First, if advertising increases concentration, one may choose to pass legislation which will stave off this process. Second, advertising may be responsible for the observed increases in concentration in consumer goods industries.[3]

This paper presents several new approaches to the advertising-concentration discussion. It infers a relationship between advertising and sales for firms of different sizes in an industry. It employs data which describe theoretical industries at roughly the 5-digit level. It focuses on changes in concentration rather than levels of concentration. It suggests an unexplored avenue by which advertising might increase concentration. Finally, it develops an original test to analyze advertising's effect on concentration.

II. Problems with Prior Studies

Previous studies of advertising's effect on concentration have tended to examine the relationship between an industry's advertising-sales ratio and the industry's concentration ratio.[4] The expectation of some relationship was based on advertising's ability to create a product differentiation barrier to entry--which in turn led to high concentration.

There are two problems with these studies. First, there is a causation question. When one relates levels of concentration to advertising intensity, one may discover that high concentration is associated with intensive advertising, and one may infer that product differentiation is causing high concentration. However, as Greer has observed,[5] it is possible that advertising rivalry replaces price competition when industries become concentrated. This would suggest that the high concentration causes the intensive advertising--not vice versa.

Second, the data normally used to study advertising and concentration do not conform to the barrier-to-entry argument. If barriers to entry do cause high concentration in some industries, they undoubtedly take a long time to operate. One would not expect concentration suddenly to jump or fall by large amounts as barriers to entry are erected or eliminated. For example, if a dominant firm loses a patent, its market share may erode gradually, but it is unlikely to change quickly. If intensive advertising does create barriers-to-entry which in turn cause high concentration, then the relevant measure of advertising intensity describes the intensity over the life of the industry; advertising intensity in a recent year is inadequate if one doesn't also assume that advertising has remained relatively constant throughout the industry's life. Nevertheless, empirical work has tended to relate one year's advertising to the industry's concentration. If a relationship between concentration and advertising were observed in a given year, it would be likely to run from the more stable variable--concentration--to the less stable item--advertising. Thus, the nature

of the variables examined is not conducive to a finding that advertising causes high concentration.

By analyzing changes in concentration, rather than levels of concentration, one can abate both problems. The causation problem would be reduced because changes in concentration are less likely than levels of concentration to be the cause of intensive advertising. Similarly, changes in concentration conform more closely to the barrier-to-entry argument because a small change in a concentration level might be caused by an advertising-erected barrier-to-entry.

III. A Different Outlook on the Advertising-Concentration Question

Barriers-to-entry are not the only mechanism that can relate advertising to concentration. This section suggests that advertising may increase concentration by affecting different size firms' sales differently. The model considers changes in sales rather than levels of sales because--as with concentration--dealing with changes reduces the causation problem.

There are two reasons unequal size firms may have different relationships between advertising and the change in their sales. First, there may be declining costs in advertising.[6] If declining costs in advertising obtain, then large advertisers pay less per unit of advertising than small advertisers. Advertising, then, constitutes a downward-sloping component of the average total cost curve. If non-advertising costs are constant for all outputs, then average total costs will be downward sloping due to advertising's contribution. In other words, large and

small firms would be on an equal footing in the absence of advertising; due to advertising's existence, large firms have a unit cost advantage.

Second, the effectiveness of a firm's advertising may be a positive function of the firm's size. (This differs from declining costs of advertising because here we are saying advertising's effectiveness may depend on the firm's size, while there we were saying it might depend on the amount the firm advertises.) If the success of a firm's advertising is a positive function of the firm's size, then a dollar of a large firm's advertising is more effective in increasing sales than a dollar of a small firm's advertising is. If other factors influencing growth rates are the same for all size classes of firms, then advertising will enable large firms to grow at a more rapid rate than small firms, and concentration will rise.

The success of a firm's advertising may depend on the firm's size for two reasons. First, large firms are better known than small firms. Advertising's initial task is to create consumer awareness of a brand's existence. When a product is part of a large company's brand line, fostering awareness may be less problematic. The large firm may be able to direct its advertising toward improving the consumer's attitude toward the product. The smaller firm--worrying about awareness as well as attitude-development--may be at a decided disadvantage.

Large firms' advertising may also be more effective than small firms' advertising because the large firms' products are more widely distributed. For example, one finds Good Seasons Salad Dressing at all super markets, but it is easy to find a store that does not stock Trader Vic's salad dressing. If one assumes that all firms' advertising is

equally effective in persuading new customers to ask for the advertiser's brand first, then all firms will increase their sales in proportion to their advertising expenditures--providing each firm's product is available when the customer asks for it. If advertising is not powerful enough to induce the consumer to try another store, then a brand that is not carried by every merchandiser will lose some of its potential customers to its rivals. This firm's advertising will be less effective than the advertising of the fully-distributed products because of the difference in availability.

One can test the propositions presented above by contrasting the effectiveness of large and small firms' advertising. (Throughout this paper, the term "effectiveness of advertising" refers to advertising's ability to augment the firm's sales.) If there is a difference in effectiveness that is related to the amount of advertising the firm undertakes, then one has evidence of declining costs in advertising. If large firms have more effective advertising but this advantage is unrelated to the amount they advertise, then there is evidence that the large firms' reputations or distribution networks enhance the effectiveness of their advertising.

One can measure advertising's effectiveness in increasing a firm's sales by regressing the change in sales on the amount the firm spends on advertising. To obtain an unbiased estimate of advertising's effectiveness, one must include in the regression all other variables that might affect the firm's sales. The most apparent of these are:

Advertising by the Firm's Rivals--Rivals' advertising should have two effects. First, it should increase industry sales with some of the increase going to the firm we are studying. Second, it should attract customers from the firm being studied. The second effect is likely to dominate. Therefore, we expect rivals' advertising to reduce the firm's sales.

The Firm's Relative Price in the Industry--If advertising attracts new customers to the industry, more are likely to gravitate toward lower priced items than higher priced items as long as differences in price are not equally matched by differences in quality.

Changes in the Firm's Relative Price--If the firm reduces its price relative to its rivals' prices, its sales should increase at its rivals' expense.

The Initial Level of the Firm's Sales--If all firms grow by the same percent due to secular growth in demand, then the firm's sales in the initial period will measure the base from which its percentage growth departs. A larger base implies a larger absolute change.

The Stage in the Business Cycle--Growth in secular demand will affect all firms' growth rates and will vary with the business cycle.

The Product's Stage in its Life Cycle--Most products seem to experience a life cycle during which they are introduced, enjoy rapid growth, experience stable sales, and finally have declining sales. The firm's change in sales will be affected by its product's current stage in its life cycle.

As we shall see, not all these variables have been included in the regressions reported here. For some variables, data were inadequate. Others were excluded from the regression because they had no significant impact on either the dependent variable or the coefficients of the remaining variables. One variable--the business cycle measure--was excluded because the sample is a cross section of firms rather than a time series. The stage in the business cycle is the same for all observations. Therefore, we could not measure how the business cycle affected a firm's sales. Suffice it to say that results found in this paper are not necessarily generalizable to other stages in the business cycle. Changes in aggregate demand may influence the relative growth rates of large and small firms. If fluctuations in aggregate demand also affect advertising's impact on sales, then the results found here are only valid for the expansion phase of the cycle covered by the data used here.

IV. Data

The sample employed consisted of 325 firms in 53 consumer-goods industries. Observations encompassed a company's operations in a given four- or five-digit industry. Companies were included in the sample only if either: 1) the company's entire business fell within a single theoretical industry during the sample period, or 2) adequate breakdowns of the company's sales and advertising were available by industry during the sample period. When adequate breakdowns were available for more than one industry, the company's operation in each of these industries counted as a separate observation. This procedure is recommended for allocating diversified companies' operations to industries. It differs from the conventional method of allocating all a company's activities to its primary industry.[7]

Advertising data came from <u>Advertising Age</u> and <u>National Advertising Investments</u> (<u>NAI</u>). <u>Advertising Age</u> data cover eight media, while <u>NAI</u> data only include four media. On the other hand, <u>NAI</u> reports on all companies that spend over $25,000 per year on advertising, while <u>Advertising Age</u> only covers the top 125 advertisers. Also, <u>NAI</u> breaks down the companies' advertising by product. <u>Advertising Age</u> has some breakdowns of most companies' advertising, but often the breakdown is incomplete.

Faced with two quite distinct types of advertising data, it was necessary to make some adjustments. One assumption was sufficient--that for any industry, the ratio of advertising expenditures in the four <u>NAI</u> media to the eight <u>Advertising Age</u> media is the same for all firms. Having made this assumption, the ratio of <u>Advertising Age</u> advertising to <u>NAI</u> advertising was computed for all firms for which both figures were available. An average ratio was calculated for each industry. This ratio was then multiplied by the more widely available <u>NAI</u> figures for other firms in each industry. By this method, <u>NAI</u> figures were made comparable to the eight media <u>Advertising Age</u> numbers.

Two aspects of the data merit special observation. <u>NAI</u> only breaks down television advertising by product during the years 1967 and 1968. In other years, it presents a company's television advertising as an undivided total, while it subdivides the advertising in other media by product. Since a breakdown of the firm's advertising is crucial to our approach to the data, the study was confined to the period 1967-1968. Second, <u>NAI</u> does not report the advertising of firms that spend less

than $25,000 per year on advertising. One of the variables in our model is rivals' advertising. To the extent that small firms' advertising is not reported, this variable will be poorly measured. The error introduced from this source is unknown but probably minor.

Sales data were compiled from two sources. Advertising Age often reports companies' sales by product along with its advertising data. Where these figures were available, they were used. For most other companies, the company's annual report provided the basis for the sales breakdowns. In many instances, the breakdown was not available; in these cases, the company was dropped from the sample--though, its advertising was retained as part of rival's advertising for other firms in its industry.

The advertising data were used to form variables measuring both the firm's own advertising and its rivals' advertising. In preliminary regressions, two other variables were tried and dropped due to their having no perceptible influence on either the dependant variable or the coefficients of the other independent variables. One of these variables was a dummy representing the product's relative price in the industry. This dummy was constructed largely on the basis of surveys of consumer magazines for the prices of durable goods. For food and drugs, which were not covered by consumer magazines, a survey was conducted in the Berkeley-Oakland (California) area of 1971 relative prices. A dummy value of high, medium, or low was assigned on the basis of 1971 prices. Use of this dummy required the assumption that relative prices are generally stable within the high, medium, low range covered by the dummies.

The second variable that was dropped from the final regressions was a dummy for the product's stage in its life cycle. Products were divided into 1) those that were relatively new during 1967-1968 and, hence, were in the stages of introduction and growth, or 2) those that had passed the growth stage and were at the "mature" level of relatively stable sales. No products in our sample were deemed to be in the still-later stage of a product's life cycle where the product is passing out of use and where sales are falling.

Finally, changes in relative price is a variable that is both missing from the regressions and likely to belong in the equation. One expects that a product's sales rise when its relative price falls and that its sales fall when its relative price rises. However, no data were available on changes in relative price during the sample period. There are two defenses for proceeding without such an important variable. First, most of the industries in the sample are oligopolistic. In these industries, price competition might be expected to be rare, and to be overshadowed by advertising rivalry. Second, if changes in relative prices are independent of both the amount and effectiveness of advertising and independent of the size of the relevant firm, then the absence of this variable does not affect our test results. While these are stringent conditions, there are at least no well-established theories relating changes in relative price to any of these variables.

Table 1 presents the industries included in the sample.[9] The industries are divided into four sectors--expensive items, drugs, food, and household products. The firms in each of these sectors are treated

separately with a distinct equation fit for each one. To regress the entire sample together would require assuming that the relationship between advertising and the change in sales is the same for all firms in the economy. This is a somewhat implausible assumption. Ideally, one could fit a separate equation for each firm--or at least each industry--in the economy. The number of observations required to obtain good estimates forbade fitting a hyperplane to each firm or industry. The compromise was to regress each sector separately and, hence, to assume that the relationship between advertising and the change in the firm's sales is the same for all firms in similar industries.

V. Test Methods and Test Results

GENERAL SPECIFICATION

Previous sections have suggested that the equation we wish to estimate is some specification of:

(1) $\Delta S_t = f(S_{t-1}, A, AO)$

where ΔS_t = the change in a firm's sales between period t-1 and t

S_{t-1} = the firm's sales during period t-1

A = the firm's advertising, certainly during period t, and perhaps also during period t-1, t-2, etc.

AO = the firm's rivals' advertising, also during period t, and perhaps during periods t-1, t-2, etc.

Several questions remain unanswered about the appropriate form of the advertising variables. Is it strictly concurrent with the change in sales? Is the dollar expenditure on advertising the relevant variable? Or should one instead introduce lagged advertising and perhaps focus on advertising-sales ratios?

Given sufficient data, equation (1)'s most general form would include many lagged advertising terms. Since our advertising data cover only 1967 and 1968, however, only figures for those years could be used. As a result, the form of equation (1) that was estimated had one current and one lagged term for both the firm's own and its rivals' advertising. (The change in sales variable measured 1968 sales minus 1967 sales, and the initial-period-sales variable measured 1967 sales.)

Three specifications of the advertising variable were tried in equation (1). These were absolute dollar expenditures on advertising, the advertising-sales ratio, and the ratio of the firm's advertising to its rivals' advertising. The advertising-sales ratio expression did not perform as well as the other two formulations; only results on absolute advertising expenditures and the ratio of the firm's to its rivals' advertising will be reported.

The two resulting equations are:

$$(2)\quad \Delta S_t = B_0 + B_1 S_{t-1} + B_2 A_t + B_3 A_{t-1} + B_4 AO_t + B_5 AO_{t-1} + e_2$$

and

$$(3)\quad \Delta S_t = B_o + B_1 S_{t-1} + B_2 \; {}^{A_t}/_{AO_t} + B_3 \; {}^{A_{t-1}}/_{AO_{t-1}} + e_3$$

Before either equation was suitable for estimation, heteroscedasticity had to be eliminated. It was unlikely that the errors of all firms in the sample would have uniform variances. More likely, the variances would vary directly with the firm's size. To correct for heteroscedasticity, the squares of the residuals in the unadjusted linear forms of equations (2) and (3) were regressed on each firm's 1967 sales and on various forms of the sales variable. All terms in

the equation were then divided by the square root of the sales variable form that was most highly correlated with the square of the residuals. For example, in the expensive-items-sector fitting of equation (2), the square of the residuals was most highly correlated with the square root of 1967 sales. Therefore, each variable in equation (2) was divided by the fourth root of 1967 sales when the expensive-items sector was tested. This procedure normalized the variables and generated a homoscedastic sample. The resulting least squares estimates are best linear unbiased under the normal Gauss-Markov assumptions.

Tables 2 and 3 present estimates of equations (2) and (3) for the whole sample after the adjustment for heteroscedasticity. The multiple correlation coefficients are moderately high for cross section studies--thereby lending support to the contention that the independent variables help explain changes in the firm's sales.

MULTICOLLINEARITY

In assessing advertising's impact on the change in the firm's sales, one wishes to estimate how a dollar of advertising changes sales in the long run. If sales increase by B_2 dollars immediately after one spends a dollar on advertising, if they decrease by B_3 dollars during the following period, and if they remain constant hereafter, then one is interested in estimating $(B_2 - B_3)$--the net change in sales produced by a dollar of advertising.

In our equations, multicollinearity inhibits precise estimation of the relationship between advertising and concurrent changes in sales. However, collinearity does not impede estimation of $(B_2 - B_3)$. Current

and lagged advertising are collinear in our sample. These variables are positively correlated, and their coefficients have opposite signs in our equations. Under these conditions, it is possible to estimate $(B_2 - B_3)$ precisely even though neither B_2 nor B_3 can be estimated precisely by itself.[10]

MARGINAL PRODUCTIVITY TEST

To test whether there are declining costs in advertising, one can add an advertising-squared term to either the absolute expenditure or the ratio equation. The presence of the squared term permits a non-linear relationship between advertising expenditures and the change in the firm's sales. A positive coefficient on the squared term indicates that each advertising dollar increases sales by a greater amount when one advertises intensely than when one advertises lightly. This is the condition for decreasing costs in advertising. A negative coefficient on the other hand, indicates that as one advertises heavily, advertising becomes a less-effective sales builder.

If declining costs in advertising do exist, one should not conclude that firms are not profit maximizing. When we test for increasing marginal effectiveness of advertising, we hold rivals' advertising constant. The benefits from increasing advertising might appear to be positive when one assumes rivals will not change their advertising budgets while the true returns are negative because rivals will actually respond by increasing their advertising.

Tables 4 and 5 present the equations with the advertising-squared terms after the adjustment for multicollinearity. Table 4 contains the

absolute-advertising results; Table 5 shows the ratio equations. The inclusion of the squared term for rivals' advertising in Table 4 is necessary primarily for consistency. If the relationship between the firm's advertising and changes in its own sales is non-linear, then it is likely that the relationship between its advertising and change in its rival's sales is also non-linear. The rivals'-advertising-squared variable was formed by summing the squares of each rival's advertising.

The equations in Table 4 indicate declining marginal productivity of advertising in all four sectors. The signs of the advertising-squared coefficients are negative in all four sectors, and they differ significantly from zero at the 5% level in three of the four sectors. Only in the household sector--where the sign is still negative--does the coefficient on advertising squared not differ significantly from zero.

In Table 5, the results are less uniform. In three of the four sectors, the coefficient is negative but insignificantly different from zero. In the drug sector, the coefficient is positive, differing significantly from zero at the ten percent level--though not at the five percent level.

In assessing the results of the marginal productivity test, it seems reasonable to combine the readings from both tables. The expensive-items and food sectors suggest declining marginal productivity quite strongly, the household sector shows declining marginal productivity more weakly, and the drug sector yields mixed results.

DIFFERENTIAL EFFECTIVENESS OF ADVERTISING

The marginal productivity test indicates whether, at the margin, large advertisers have more or less effective advertising than small advertisers. Section III suggested that large firms' advertising might be more effective than small firms' advertising regardless of the quantities of advertising. In other words, due to a wider reputation or more thorough distribution network, a large firm's advertising may be more effective than its smaller rival's advertising even if the large firm has a lower advertising budget.

When the sample is divided into large- and small-firm subsamples, a Chow test on the advertising coefficients indicates whether large firms' advertising is more or less effective than small firms' advertising. The Chow test is performed on the equations with the squared terms included to allow for non-linearities within each size class. The test consists of ascertaining whether one can reject the joint hypothesis that large and small firms have the same coefficients on all the advertising variables in the ratio equation and on all the non-rival advertising variables in the absolute-expenditure equation.

The Chow test does not itself distinguish the cause of differential effectiveness between large and small firms' advertising; it only shows whether differential effectiveness exists. In particular, the Chow test does not tell whether it is large firms' size or their tendency to advertise more than small firms that makes their advertising more or less effective. But if the Chow test indicates that large firms' advertising is more effective, and if the squared-term test fails to

indicate increasing marginal effectiveness of advertising, then one can infer that it is factors associated with the firm's size--such as better distribution or a wider reputation--that influence advertising's effectiveness.

Tables 6 and 7 present the equations on which the Chow test were performed.[11] A comparison of large and small firms' coefficients in Table 6 reveals that the impact of small firms' advertising is greater in the expensive-items, drug, and household sector, but that large firms' advertising is more effective in the food sector.[12] In none of the four sectors is the difference in coefficients significant, however.

The advertising-ratio equations for large and small firms are shown in Table 7. Again the Chow tests fail to indicate a significant difference between the coefficients of large and small firms. Although the Chow Test is not significant for any of the four sectors, advertising has a greater impact on small firms' sales than on large firms' sales in all four sectors. If we accept as our null hypothesis that advertising increases concentration, then large firms should have greater advertising coefficients than small firms in all four sectors. Table 7 presents four independent repetitions of an experiment in which the coefficients on large and small firms' advertising are compared. The probability of small firms having larger coefficients in all four cases is one in sixteen if we assume fifty-fifty odds that the inequality go either way. If we adopt the advertising-causes-concentration position, the odds on small firms having the larger coefficient are less than fifty-fifty. Thus the odds on four successive instances of small firms having

the larger coefficient are less than one in sixteen. Being conservative, we can reject at the ten percent level--though not at the five percent level--the hypothesis that large firms' advertising is more effective.

In Tables 6 and 7, most of the coefficients on the squared terms are insignificant. This suggests that the relationship between advertising and the change in the firm's sales may be linear in advertising within each size class. Tables 8 and 9 present the equations for large and small firms when the equations are constrained in linearity.

Although none of the Chow tests on the absolute-expenditure equations in Table 8 indicates a significant difference between the coefficients, small firms' coefficients are larger than large firms' coefficients in all four sectors. The Chow tests form four independent repetitions of an experiment comparing the coefficients of large and small firms' advertising. The repetitions all show that small firms' advertising is more effective than large firms' advertising. Therefore, one can reject at the ten percent level the hypothesis that large firms have more effective advertising. One can accept the alternative hypothesis that small firms' advertising is either equally effective or more effective than large firms' advertising.

In Table 9, there is, again, no significant difference between the coefficients for any sector. Again, small firms have larger coefficients than large firms in all four sectors. In the food sector, large firms' advertising appears to reduce sales. Fortunately, this implausible coefficient does not differ significantly from zero. Again one can

reject at the ten percent level the hypothesis that large firms' advertising is more effective.

In summary, the Chow tests fail to support the hypothesis that differential effectiveness of large and small firms' advertising is the method by which advertising increases concentration. On the contrary, the Chow tests suggest that small firms' advertising is at least as effective as large firms' advertising. This implies that advertising does not increase concentration and may even reduce it.

RIVALS' ADVERTISING

Both the marginal productivity tests and the Chow tests discussed above deal with the firm's own advertising. It is possible that large and small firms grow at different rates because rivals' advertising effects them differently. In particular, small firms' growth rates may be stunted more by rivals' advertising than are large firms' growth rates because, on average, small firms have larger rivals, and therefore more rivals' advertising, working against them.

A linear specification of the relationship between advertising and changes in the firm's sales implies that large firms grow more rapidly than small firms when all firms have equally effective advertising and spend the same percent of their sales dollars on advertising. Equation (4) is a linear specification of the relationship; equation (5) shows the percentage growth in sales.

(4) $\Delta S_t = B_o S_{t-1} + B_1 A + B_2 A_0$

(5) $\frac{\Delta S_t}{S_{t-1}} = B_o + B_1 A/S_{t-1} + B_2 \frac{AO}{S_{t-1}}$

If all firms have the same advertising-sales ratios and equally effective advertising, then only the last term in equation (5) varies across firms. For small firms, the numerator of the last term will be large and the denominator will be small. Since B_2's expected sign is negative, small firms' growth will suffer more than large firms' growth as a result of their respective rivals' advertising.

By allowing equation (4) to deviate from linearity, we can test whether the relative quantities of rivals' advertising give large firms an advantage over small firms. We begin with a generalized form of equation (4) and estimate one parameter by maximum likelihood. The general form of equation (4) is:

(6) $\Delta S_t^k = B_1 S_{t-1} + B_2 A + B_3 AO$

The inclusion of K can neutralize, augment, or reverse the effect of the rivals' advertising variable. In each sector, a different value of K corresponds to large and small firms growing at equal rates. Let us call this value $\bar{K}$.[13] $\bar{K}$ is lowest in the food sector, near 1.03, and highest in the expensive-items sector, near 1.10. In both the drug and household sectors the value is near 1.04.

We test whether rivals' advertising hurts small firms more than large firms by finding a maximum likelihood estimate for K.[14] If K is less than $\bar{K}$, then small firms grow less rapidly than large firms due to the greater amount of their rivals' advertising. For values

of K greater than $\bar{K}$, small firms grow more rapidly than large firms despite the effect of rivals' advertising.

In actually performing the test, the maximum likelihood estimate[15] of K turns out to be the value of K that maximizes R^2. The variance of the estimate of K is small (of magnitude 10^{-6}) when this procedure is used. Thus, one can obtain reasonably precise estimates of K by interating over small enough intervals. Although the maximum likelihood estimate of K is very precise, the equal-growth-rate value $\bar{K}$, with which it is compared, is not measured very precisely.[16] Thus, the comparison of $\bar{K}$ with the maximum likelihood estimate is not an exceedingly powerful test.

Maximum likelihood estimates of K for the four sectors are presented in Table 10. There is remarkable uniformity of the estimates for the drug, food, and household sectors given that the estimate for the expensive-items sector is quite different. Table 10 also presents the values of $\bar{K}$ for each sector as well as a zone of ignorance around $\bar{K}$ and a confidence interval around the maximul likelihood estimate.

The estimate for the expensive items sector indicates that small firms grow more rapidly than large firms in this sector. All estimates for the other sectors suggest that rivals' advertising produces no difference between the growth rates of large versus small firms.

None of the tests discussed in this section supports the contention that large firms obtain an advantage over small firms as a result of advertising. There does not appear to be a difference in effectiveness between large and small firms' advertising either as a result of

declining costs in advertising or some size-related factors. Also, the effect of rivals' advertising does not appear to be more detrimental to small firms' growth than to large firms' growth. Despite the seemingly reasonable conjectures in Section III, this paper has presented no evidence that advertising increases concentration.

VI. Summary and Conclusions

This paper has pointed out weaknesses in the previous research on advertising and concentration, and it has offered a new hypothesis explaining how advertising might increase concentration. Several conventional tests of the hypothesis were performed. One original test was developed to ascertain whether rivals' advertising may retard small firms' growth more than large firms' growth. The results of these tests failed to support the contention that advertising increases concentration. Most of the test results indicated no difference in effectiveness between large and small firms' advertising. Where there was a difference, the results suggested that small firms' advertising was likely to be more effective than large firms' advertising. If this finding is valid, advertising may enable small firms to grow more rapidly than large firms and may actually be a deconcentrating force.

These results leave two perplexing questions: what causes the high levels of concentration in many consumer-goods industries, and what has caused concentration to rise in relatively unconcentrated industries?[17] The tests in this paper suggest that advertising is not responsible. Following many writers' precedent, I recommend these questions for further study.

TABLE 1

The Sample

Expensive Items	Drugs	Food	Household
air conditioning-home	baby products	baby food	cleaners
air lines	cold medicines	beer	detergent
autos	cologne & perfume	candy	incecticide
dishwasher	cosmetics	cereal	light bulb
electric knife	deoderants	coffee	pen
gasoline	feminine hygiene	cooking oil	pet food
laundry equipment	hair - including shampoo	dairy	paper products
photo equipment	lather	diet products	soap
refrigerator	mouthwash	gum	shoes
tire	razor & shaver	liquor	toys
television	sun tan products	margarine	wax
vacuum cleaners	toothpaste	instant rice	wrapping foil
		snacks	
		soft drinks	
		soup	
		tea	
		tobacco	

TABLE 2

Equations with Absolute-Advertising Specification

Sector	S_{t-1}	A_t	A_{t-1}	AO_t	AO_{t-1}	C	R^2
Expensive Items	.07 (.02)	13.9 (4.8)	-8.5 (5.8)	-.74 (1.40)	1.07 (1.68)	14,064 (11,781)	.658
Drugs	.13 (.02)	.64 (.28)	-.48 (.26)	-.093 (.081)	.085 (.090)	-688 (1710)	.363
Food	-.02 (.04)	.43 (.24)	.17 (.19)	.17 (.12)	.21 (.19)	-94,533 (65,548)	.218
Household	.23 (.05)	1.54 (1.38)	-1.41 (1.27)	-.34 (.68)	.29 (.71)	-2,224 (4,094)	.260

Dependent variable: ΔS_t.

The entries in the table are the coefficients of each variable. Standard errors are in parentheses.

All variables are measured in $1,000's.

TABLE 3

Equations with Ratio Specification

Sector	S_{t-1}	A_t/AO_t	A_{t-1}/AO_{t-1}	C	R^2
Expensive Items	.12 (.013)	1685 (4818)	-294 (5622)	-1186 (12634)	.556
Drugs	.12 (.02)	1676 (429)	-1158 (328)	-1387 (1279)	.416
Food	.06 (.01)	-952 (1114)	1170 (1201)	-571 (2121)	.140
Household	.12 (.04)	244 (77)	-125 (71)	374C (2531)	.490

Dependent variable: ΔS_t.

The entries in the table are the coefficients of each variable. Standard errors are in parentheses.

The advertising variables are measured in units. All others are measured in \$1,000's.

TABLE 4

Absolute Expenditure Equations With Squared Terms

SECTOR	S_{t-1}	A	A^2	AO	AO^2	C	R^2
Expensive Items	.059 (.011)	6.8 (1.3)	$-.91 \times 10^{-4}$ $(.08 \times 10^{-4})$	-.22 (.85)	5.72 (3.22)	5011 (6215)	.842
Drugs	.13 (.02)	1.6 (0.4)	$-.12 \times 10^{-3}$ $(.02 \times 10^{-3})$	.04 (.09)	-.178 (2.01)	1780 (2105)	.432
Food	.072 (.011)	.15 (.18)	$-.74 \times 10^{-4}$ $(.36 \times 10^{-4})$	.02 (.03)	-.81 (.79)	1823 (1742)	.316
Household	.24 (.04)	.61 (1.79)	$-.11 \times 10^{-4}$ $(.38 \times 10^{-4})$	.27 (.85)	-1.42 (15.86)	-923 (2018)	.292

Dependent Variable: ΔS_t Standard errors are in parenthesis

All advertising variables are differences between quantities in period t and t-1.

All variables are measured in \$1,000's, except AO^2, which is measured in \$1,000,000's.

TABLE 5

Ratio Equations with Squared Term

Sector	S_{t-1}	A/AO	$(A/AO)^2$	C	R^2
Expensive Items	.12 (.01)	4,530 (6,210)	-27.6 (41.6)	-517 (986)	.554
Drugs	.12 (.02)	347 (190)	1.35 (.69)	-414 (785)	.432
Food	.06 (.02)	1,188 (2,357)	-.41 (.29)	-100 (15)	.219
Household	.11 (.03)	152 (37)	-.72 (.47)	-218 (465)	.495

Dependent Variable: ΔS_t

S_{t-1} is measured in \$1,000's. Standard errors are in parentheses

The advertising ratios are differences between periods t and t-1. The ratio variables are measured in units.

TABLE 6

Absolute Advertising Equations

Sector	Size	S_{t-1}	A	A^2	AO	AO^2	C	R^2	N
Expensive Items	Large	.05 (.01)	2.52 (.36)	$-.47 \times 10^{-4}$ $(.18 \times 10^{-4})$	.59 (.48)	-.06 (.11)	8574 (7699)	.924	47
	Small	.06 (.01)	4.03 (1.29)	$-.11 \times 10^{-3}$ $(.09 \times 10^{-3})$	1.02 (1.14)	.32 (.21)	4175 (6732)	.864	32
Drugs	Large	.12 (.03)	.32 (.43)	$.52 \times 10^{-4}$ $(.39 \times 10^{-4})$	-.06 (.84)	-.002 (.002)	-231 (546)	.434	43
	Small	.22 (.04)	5.28 (3.96)	$-.71 \times 10^{-4}$ $(.48 \times 10^{-4})$	.38 (.21)	$-.15 \times 10^{-3}$ (4.27×10^{-3})	817 (952)	.765	28

TABLE 6 (cont.)

Sector	Size	S_{t-1}	A	A^2	AO	AO^2	C	R^2	N
Food	Large	.07	1.29	$-.16 \times 10^{-3}$	.27	-1.02	1426	.294	46
		(.02)	(.98)	$(.24 \times 10^{-3})$	(.35)	(1.02)	(5812)		
	Small	.08	.15	$-.16 \times 10^{-3}$	-.06	-1.17	1273	.525	73
		(.01)	(.41)	$(.25 \times 10^{-3})$	(.08)	(.11)	(734)		
Household	Large	.24	.41	$-.13 \times 10^{-4}$	-.11	.04	-427	.337	31
		(.05)	(.87)	$(.14 \times 10^{-4})$	(.36)	(.03)	(1163)		
	Small	.38	.65	$-.15 \times 10^{-4}$	-.26	-.12	-4816	.534	27
		(.09)	(1.02)	$(.33 \times 10^{-4})$	(.35)	(.23)	(5002)		

Dependent Variable: ΔSt

All variables are measured in \$1,000's, except AO^2, which is measured in \$1,000,000's

Standard errors are in parentheses

TABLE 7

Advertising Ratio Equations

Sector	Size	S_{t-1}	$^{A}/AO$	$(^{A}/AO)^2$	C	R^2	N
Expensive Items	Large	.11 (.15)	6,829 (7,531)	-.93 (1.04)	1583 (6495)	.287	47
	Small	.12 (.02)	48,306 (65,117)	-.68 (0.92)	842 (1066)	.497	32
Drugs	Large	.13 (.03)	8,015 (5,293)	-.04 (.05)	-1605 (1488)	.284	28
	Small	.12 (.02)	15,397 (4,716)	-.003 (.027)	-4835 (5162)	.833	43

TABLE 7 (cont.)

Sector	Size	S_{t-1}	$(^A/AO)$	$(^A/AO)^2$	C	R^2	N
Food	Large	.09 (.02)	2,387 (3,716)	-.23 (.33)	-847 (1086)	.435	46
	Small	.05 (.02)	4,951 (5,653)	-.11 (.12)	312 (451)	.154	73
Household	Large	.11 (.05)	81 (52)	-.15 (.11)	79 (953)	.194	31
	Small	.35 (.08)	1,279 (1,422)	-.12 (.09)	1118 (953)	.505	27

Dependent Variable: ΔS_t

All variables are measured in $1,000's except the advertising ratios, which are measured in units.

Standard errors are in parentheses

TABLE 8

Linear Absolute Expenditure Equations

Sector	Size	S^{i}_{t-1}	A	AO	C	R^2	N
Expensive Items	Large	.16 (.04)	.87 (.62)	-.25 (.14)	-813 (367)	.188	47
	Small	.06 (.03)	4.23 (2.26)	+1.82 (3.09)	-84,601 (51,993)	.554	32
Drug	Large	.16 (.05)	-.02 (.86)	-.071 (.050)	-412 (307)	.352	28
	Small	.13 (.04)	.24 (.11)	-.018 (.025)	-913 (796)	.322	43

TABLE 8 (cont.)

Sector	Size	S_{t-1}	A	A0	C	R^2	N
Food	Large	.06 (.02)	.40 (.32)	-.04 (.12)	2859 (3007)	.186	46
	Small	.04 (.05)	.73 (.36)	.08 (.08)	810 (916)	.017	73
Household	Large	.21 (.09)	.45 (.37)	.12 (.39)	-512 (911)	.048	31
	Small	.02 (.10)	.57 (.29)	.14 (.15)	2182 (3647)	.196	27

Dependent variable: ΔS_t

All variables are measured in \$1,000's.

Standard errors are in parentheses

TABLE 9

Linear Ratio Equation

Sector	Size	S_{t-1}	$^{A}/A0$	C	R^2	N
Expensive Items	Large	.07 (.02)	194 (91)	3218 (1705)	.152	47
	Small	.12 (.02)	1930 (4826)	812 (953)	.374	32
Drugs	Large	.11 (.05)	127 (58)	-632 (138)	.195	28
	Small	.11 (.03)	652 (713)	-937 (856)	.346	43

TABLE 9 (cont.)

Sector	Size	S_{t-1}	$^{A}/AO$	C	R^2	N
Food	Large	.05 (.03)	-115 (908)	054 (123)	.007	46
	Small	.08 (.01)	306 (452)	-708 (1129)	.121	73
Household	Large	.12 (.05)	46 (35)	-213 (502)	.194	31
	Small	.16 (.07)	185 (120)	-3,840 (2,652)	.125	27

Dependent variable: ΔS_t

All variables are measured in \$1,000's, except $^{A}/AO$, which is measured in units.

Standard errors are in parentheses

TABLE 10

Sector	$\overline{K}$	Zone of Ignorance Around $\overline{K}$	Maximum Likelihood Estimate of K	95% Confidence Interval Around MLE
Expensive Items	1.10	1.04 - 1.16	2.05	2.04 - 2.06
Drugs	1.04	1.00 - 1.09	1.05	1.04 - 1.06
Food	1.03	0.99 - 1.07	1.05	1.04 - 1.06
Household Items	1.04	1.01 - 1.07	1.05	1.04 - 1.06

Footnotes

[1]Lester G. Telser, "Advertising and Competition," Journal of Political Economy, LXXII, No. 6, December, 1964, pp. 532-562. Lester G. Telser, "Another Look at Advertising and Concentration", Journal of Industrial Economics, 18, No. 1, Nov., 1969, pp. 85-94. Robert Ekelund and William Gramm, "Advertising and Concentration: Some Evidence," Antitrust Bulletin, 15, No. 2, Summer, 1970, pp. 243-249. Robert Ekelund and William Gramm, "Advertising and Concentration: More on Tests of the Kaldar Hypothesis," Antitrust Bulletin, 16, No. 1, Spring, 1971, pp. 106-109. Robert Ekelund and Charles Maurice, "An Empirical Investigation of Advertising and Concentration: Comment, " Journal of Industrial Economics, 18, No. 1, Nov., 1969, pp. 76-80.

[2]H. M. Mann, J. A. Henning and J. W. Meehan, Jr., "Advertising and Concentration: An Empirical Investigation," Journal of Industrial Economics, 16, No. 1, Nov., 1967, pp. 34-45. H. M. Mann, J. A. Henning, and J. W. Meehan, Jr., "Testing Hypotheses in Industrial Economics: A Reply," Journal of Industrial Economics, 18, No. 1, Nov., 1969, pp. 81-84. H. M. Mann, J. A. Henning, and J. W. Meehan, Jr., "Statistical Testing in Industrial Economics: A Reply on Measurement Error in Sampling Procedure," Journal of Industrial Economics, 18, No. 1, Nov., 1969, pp. 95-100. H. M. Mann, and J. A. Meehan, Jr., "Advertising and Concentration: New Data and an Old Problem," Antitrust Bulletin, 16, No. 1, Spring, 1971, pp. 101-104.

[3]The increase in concentration in consumer-goods industries is documented in Willard F. Mueller, A Primer on Monopoly and Competition, Random House, New York, 1970, pp. 29-38. Mueller attributes increase to extensive advertising and promotion since World War II.

[4]In particular, Telser, Ekelund, Gramm, Maurice, Mann, Henning, and Meehan all regress concentration ratios on advertising-sales ratios for cross-sections of three-or four-digit industries. Ekelund and Gramm and Ekelund and Maurice try the relationship in its first difference form also.

[5]Douglas Greer, "Advertising and Market Concentration," Southern Economic Journal, 38, No. 1, July, 1971, pp. 19-32.

[6]In theory, declining costs in advertising may stem from either of two sources. First, the cost of an advertising message may decline as one buys more messages. Second, the effectiveness of each message may decline as one advertises more. For example, if consumers have threshholds which must be crossed before they respond to a firm's advertising, or if they merely respond increasingly favorably as they have contact with more of a firm's advertising, then the more a firm advertises the lower will be the cost of increasing sales by one more unit. Blank and Peterman, independently, have shown that media do not give discounts to large advertisers. (See David M. Blank, "Television Advertising: The Great Discount Illusion, or Longpardy Revisited," Journal of Business, 41, No. 1, Jan., 1969, pp. 10-38, and John L. Peterman, "The Clorox Case and the Television Rate Structures," Journal of Law and Economics, XI, No. 2 October, 1969, pp. 321-422.) This eliminates the first possibility. In the following sections, we discuss and test the second possibility.

[7] The procedure employed was suitable for this study on sales and advertising because figures on sales and advertising breakdowns are less scarce than are data on other aspects of a firm's behavior. If the Federal Trade Commision succeeds in requiring the reporting of detailed breakdowns of companies' activities, this method will be available for a wider range of studies.

[8] The rivals' advertising variable was formed by summing the advertising of all other firms in the relevant four-or five-digit industry. Geographic adjustments were made in the petroleum, airline, beer, and dairy industries so that only the appropriate portion of a national rival's advertising was included in the rivals' advertising variable for a regional firm. Two alternative formulations of the rivals' advertising variable performed no better than the sum of all rivals' advertising. These alternatives were the advertising of only large rivals and the advertising of only rivals of comparable size to the firm under observation.

[9] Table 1 presents only one of many possible ways to group industries. To see whether the results of the study change dramatically when the industries are regrouped, one other classifying system was tried. Industries were divided into either a) necessities and convenience goods, or b) shopping goods and specialty items. The former class includes items that are bought frequently and where habit is presumed to strongly influence brand choice. The latter group includes items that are bought less frequently. Shopping goods are commodities whose prices the consumer studies carefully. Specialty items are those for which he has been convinced to buy a particular brand before he goes shopping. While the particular numbers change if one uses this alternative industry classification scheme, the fundamental results remain the same.

[10] Collinearity never affects the estimation of one linear combination of the collinear variables. If X and Y are the collinear variables, and if $X = Ky + e$, then collinearity does not effect the estimate of the coefficient on $X - Ky$ (assuming the coefficients on X and Y have opposite signs in the equation). In our case, K is near one. Across firms, current and lagged advertising move together dollar for dollar. Therefore, we can estimate $(B_2 - B_3)$ precisely.

[11] There are at least two bases for dividing the sample--size and market share. The results reported here refer to divisions on the basis of firm size. Interestingly, employing the market share division did not change the test results--though it affected the coefficient values. The results from the sales division are reported here because differences in firms' reputations and distribution networks are more likely to be associated with absolute than relative size.

[12] To compare the effectiveness of small and large firms' advertising, we wish to combine the squared and unsquared components. The two effects are combined for each size class by multiplying each coefficient by the average value of the corresponding variable and then summing the products. This procedure yields advertising's expected impact on sales for each size class.

[13] To calculate the value $\overline{K}$ that corresponds to equal growth rates for large and small firms, we first divide our sample into large and small firms. We then find the predicted ΔS_t for each size class under the assumption that the B's are the same for the two size classes; we use the average values of the independent variables within each size class to predict ΔS_t. When this procedure is followed, large firms' predicted growth rates are larger because the large firms are affected less negatively by rivals' advertising. We, therefore deflate the predicted ΔS_t for both large and small firms by $1/\overline{K}$, choosing $\overline{K}$ so that:

$$\Delta S_l^{1/\overline{K}}/S_{l(t-1)} = \Delta S_s^{1/\overline{K}}/S_{s(t-1)}$$

where:

ΔS_l = predicted change in sales for large firms between periods t-1 and t;

ΔS_s = predicted change in sales for small firms between periods t-1 and t;

$S_{l(t-1)}$ = average sales of large firms during period t-1.

$S_{s(t-1)}$ = average sales of small firms during period t-1.

Choosing $\overline{K}$ in this manner offsets the effect of small firms having more rivals' advertising to contend with. When we adjust the dependent variable by $\overline{K}$, our equation predicts that all firms grow at the same rate.

[14] It is common practice to adjust the dependent variable by K when one does not expect a linear relationship. See Robert Masson, Executive Compensation and Firm Performance, unpublished Ph.D. dissertation, University of California, 1969, pp. 91,92. The procedure suggested here takes the further step of finding a maximum likelihood estimate of K rather than assuming a value and imposing it on the data.

[15] The maximum likelihood estimate is obtained by maximizing

$$\log\left(\frac{1}{2\pi\sigma^{2,n/2}} e^{\frac{\sum_{i=1}^{n}(\Delta S_{ti}^{k} - \sum_{j=1}^{m} B_{ji}X_{ji})^2}{2\sigma^2}}\right)$$, or equivalently

$$-\frac{n}{2}\log(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{i=1}^{n}(\Delta S_{ti}^{k} - \sum_{j=1}^{m} B_{ji}X_{ji})^2$$, with respect to K

and the B's. When one maximizes

$$-\frac{n}{2}\log(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{i=1}^{n}(\Delta S_{ti}^{k} - \sum_{j=1}^{m} B_{ji}X_{ji})^2$$, the first term drops out,

and one is left minimizing $\sum_{i=1}^{n} (\Delta S_{ti}^{k} - \sum_{j=1}^{m} B_{ji} X_{ji})^2$. This is just the sum of squared residuals of the regression. Finding the B's that maximize R^2 for a given K is equivalent to minimizing the sum of squared residuals for that K. When one iterates K and finds the K that yields the highest R^2, one finds the minimum of the sums of squared residuals.

The asymptotic variance of the maximum likelihood estimate equals

$$E\left(\frac{\partial^2 \log f(K,B)}{\partial K^2}\right)^{-1}, \text{ where } f(K,B) = \frac{1}{(2\pi\sigma^2)^{n/2}} e^{-\frac{\sum_{i=1}^{n} (\Delta S_{ti}^{k} - \sum_{j=1}^{m} B_{ji} X_{ji})^2}{2\sigma^2}}$$

Taking second partial derivatives yields:

Var(mLE) =

$$E\left[\frac{\sigma^2}{\sum_{i=1} \Delta S_{ti}^{k} \log^2(\Delta S_{ti}) \, [2\,\Delta S_{ti}^{k} - \sum_{j=1}^{m} B_{ji} X_{ji}]}\right]$$

[16] The zone of ignorance around $\bar{K}$ exists because the estimate of $\bar{K}$ is sensitive to changes in the dividing line between large and small firms. To find the zone of ignorance, we change the dividing line by fifty percent in either direction. We then recalculate $\bar{K}$. When the dividing line is raised, $\bar{K}$ drops; when the dividing line is reduced, $\bar{K}$ rises. It is unlikely that the equal-growth value of K exactly equals the value of $\bar{K}$ for any sector in Table 10. However, it is very likely that the equal-growth value of K lies within the zone of ignorance around $\bar{K}$ in all sectors.

[17] Joe S. Bain, "Changes in Concentration in Manufacturing Industries in the United States, 1954-1966: Trends and Relations to the Levels of 1954 Concentration," Review of Economics and Statistics, LII, No. 4, Nov., 1970, pp. 411-416.

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